

NEW TAXA AND A NEW COMBINATION IN TASMANIAN POACEAE

by

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ABSTRACT

Morris, D. I. New taxa and a new combination in Tasmanian Poaceae. *Muelleria* 7(2):147–171 (1990). Eight new species *Agrostis lacunis*, *Danthonia diemenica*, *Danthonia nitens*, *Danthonia popinensis*, *Danthonia remota*, *Deyeuxia apsleyensis*, *Deyeuxia innominata*, *Poa jugicola*, three new varieties *Agrostis billardieri* R. Br. var. *collicola*, *Agrostis billardieri* R. Br. var. *tenuiseta*, *Poa poiformis* (Labill.) Druce var. *ramifer* are described and a new combination *Pentapogon quadrifidus* var. *minor* is made.

INTRODUCTION

The last comprehensive account of Tasmanian grasses was Rodway (1903). Subsequently *A species list of and keys to the grasses in Tasmania* was published by Townrow (1969). In the course of preparation of the section on the Poaceae for part 4B of *The Students Flora of Tasmania* a number of novelties emerged. As publication of part 4B of the Flora is still some time off, these taxa are described below to make the names immediately available. Under the 'distribution' headings the regions given are those in *A natural regions map for Tasmania* (Orchard 1988).

AGROSTIS L.

***Agrostis billardieri* R. Br. var. *collicola* D. Morris var. nov.**

A Agrostis billardieri R. Br. var. *billardieri* arista lemmatis subterminali tenui differt. *A Agrostis billardieri* var. *tenuiseta* D. Morris statura parvior (usque ad 15 cm altam), panicula parvior, spiculis paucis, in regionibus interioribus praesenti ad c. 800 m altitudinem differt.

TYPUS: Tasmania, Saddle between The Hippo and Moonlight Ridge Hill, c. 800 m altitude. Exposed situation with very little vegetation, 10 Feb. 1985, P. Collier 309 (HOLOTYPE: HO 93165).

Differs from *Agrostis billardieri* var. *billardieri* in having a slender subterminal awn. Differs from *Agrostis billardieri* var. *tenuiseta* in its smaller stature (up to 15 cm high), smaller panicle with few spikelets. Occurs inland at c. 800 m altitude. (Figs. 1, 2a)

DISTRIBUTION:

Tasmania; Central Highlands, SW, known only from the type and from a second collection: Lake Ewart, 850 m, herb lawn on stream bank, 7 Feb. 1987, A. M. Buchanan 10071 (HO).

ETYMOLOGY:

Collicola, dwelling in hills, relating to habitat.

***Agrostis billardieri* R. Br. var. *tenuiseta* D. Morris var. nov.**

A Agrostis billardieri R. Br. var. *billardieri* arista lemmatis subterminali, tenui, infirma, stricta, usque ad 4 mm longam vel absenti differt.

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Fig. 1. Holotype of *Agrostis billardieri* var. *collicola*.

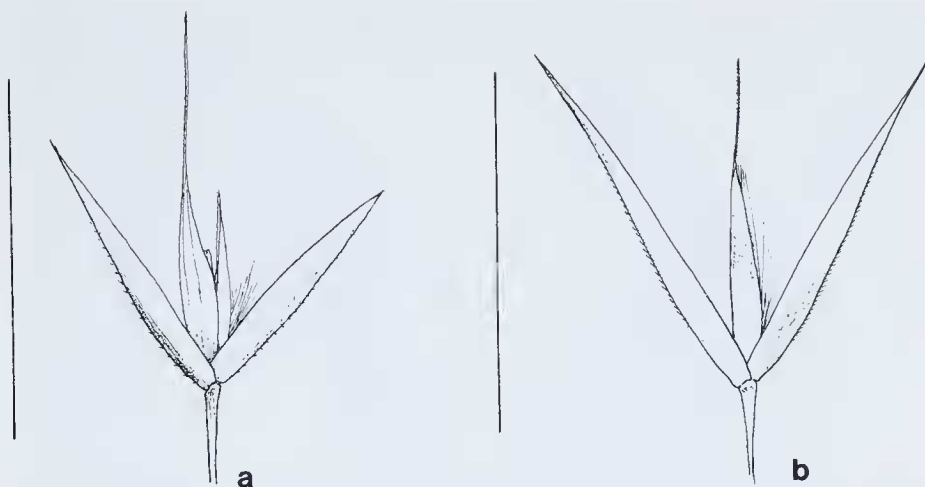


Fig. 2. a—Spikelet of *Agrostis billardieri* var. *collicola*. b—Spikelet of *Agrostis billardieri* var. *tenuiseta*. Scale lines = 5 mm.

TYPUS: Tasmania, Dolphin Sands, Nine Mile Beach, 3 m altitude, seaward face of frontal dune, dominated by *Ammophila arenaria*, 10 Dec. 1984, A. M. Buchanan 4763 (HOLOTYPE: HO 889020; ISOTYPE: NSW).

Differs from *Agrostis billardieri* var. *billardieri* in having a weak, straight, slender subterminal awn up to 4 mm long, or the awn absent. (Figs. 2b, 3)

DISTRIBUTION:

Tasmania; East coast and Furneaux Group, coastal sands.

SPECIMENS EXAMINED:

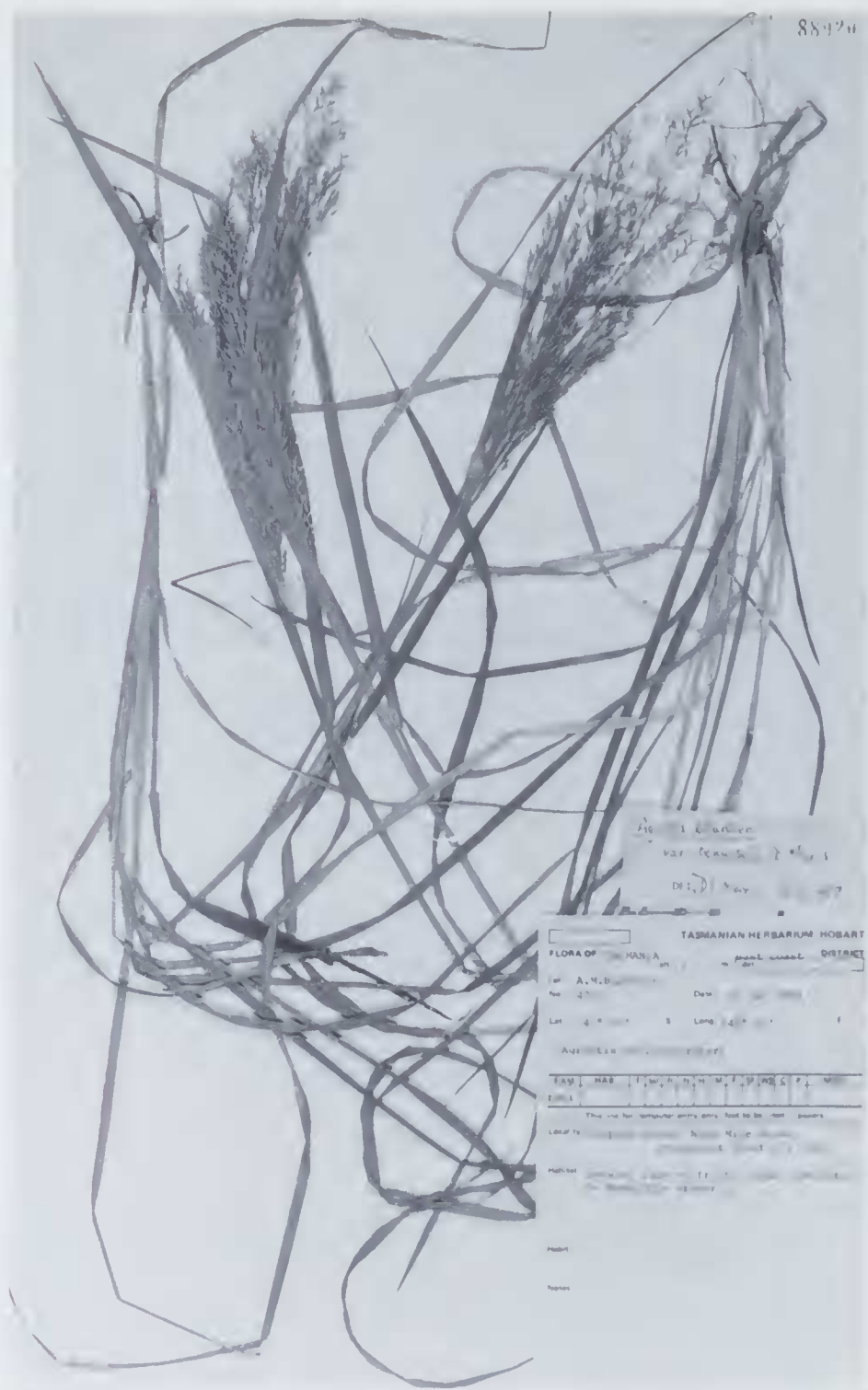
Tasmania—Whitemark, Flinders Island, Dec. 1979, D. I. Morris s.n. (HO 59170); Dolphin Sands, Nine Mile Beach, 29 Oct. 1981, A. M. Buchanan s.n. (HO 71577); Nine Mile Beach, near Point Bagot, 29 Dec. 1981, A. M. Buchanan 705 (HO); Dolphin Sands, Nine Mile Beach, 20 Feb. 1983, A. M. Buchanan 1186 (HO).

ETYMOLOGY:

Tenuiseta, slender-bristled, referring to the weak lemma awn

Agrostis lacunis D. Morris sp. nov.

Gramen perenne, erectum vel geniculatum-ascendens, glabrum, saepe ad nodos inferiores radicans et ramificans, 20–40 cm altum, in aqua ad margines lacunarum lacuumque in regionibus altioribus crescens. *Vaginae foliorum* costatae, longiores quam internodi, tandem laxae; vaginae foliorum inferiorum chartaceae, vaginae foliorum superiorum virides vel purpurascens; ligulae usque ad 6 mm longae, anguste triangulares; laminae complanatae, usque ad 20 cm longae, usque ad 2.5 mm latae, virides vel purpurascens, ambobus faciebuis subtiliter costatis, superficie minute scaberula. *Culmi* teretes, laeves, infra paniculas minute scaberuli. *Panicula* usque ad 12 cm longa, ad 7 cm lata, pyramidalis, ramis ad nodos inferiores 2–4 natis, ad nodos superiores binatis, axe et ramis pedicellisque scabris, *Spiculae* (2.5–) 2.75–4.0 mm longae. *Glumae* subaequales, aliquando inferiore parum longiore, carinis faciebusque scabris, purpurascens, marginibus membranaceis. *Lemma* (1.5–) 2–2.5 mm longum, dense sericeum, apice 4–dentato, arista ad circum medium inserta, 1.5–3.25 mm longa, stricta, gracili vel geniculata columna usque ad 1.5 mm longa. *Callus* dense barbatus. *Palea* parum brevior quam lemma, tenuiter membranacea. *Seta* rhachillae c. 0.5 mm longa, pilifera, pilis saepe paene aequans lemma. *Antherae* 0.6–0.8 mm longae.



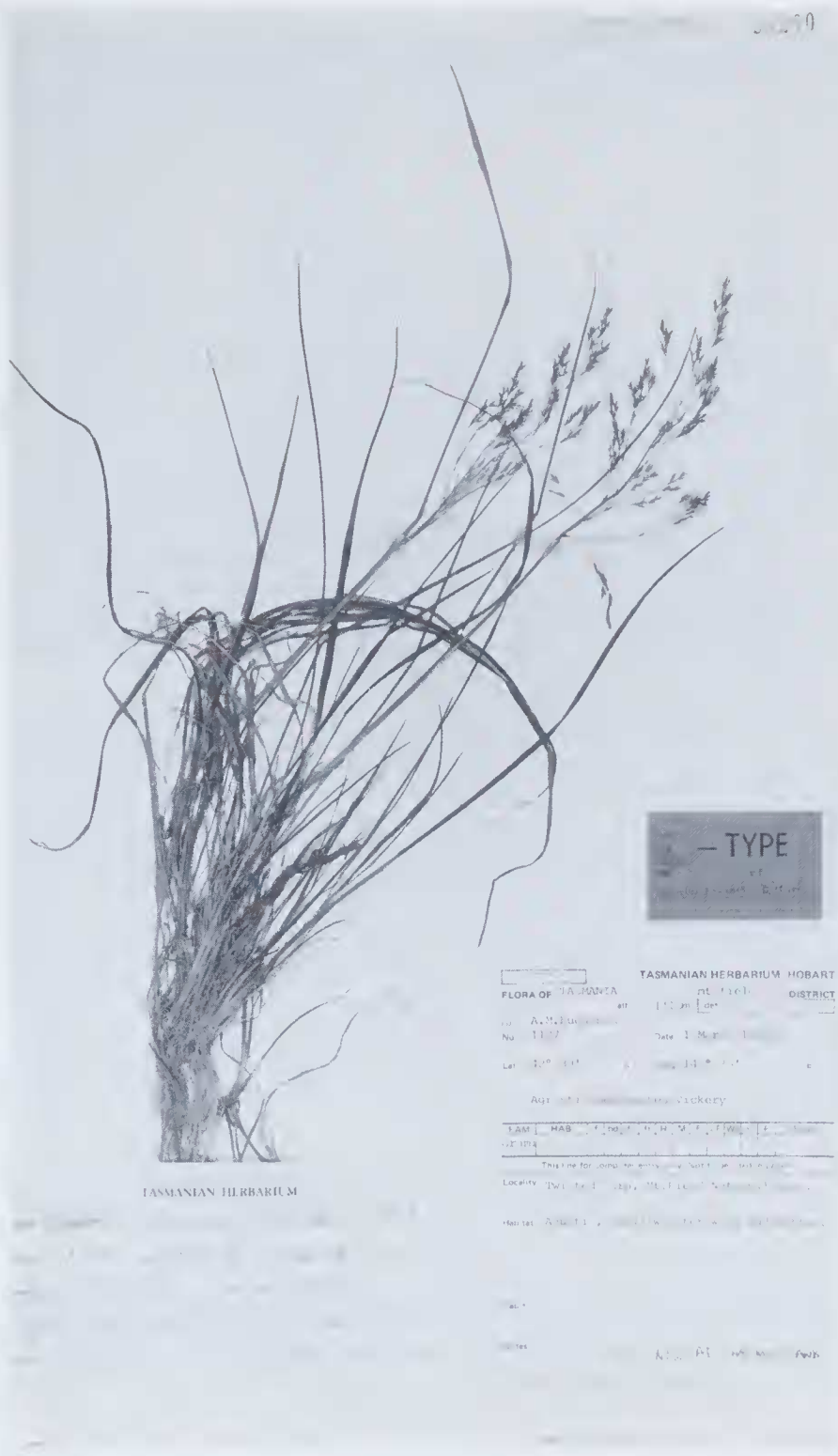


Fig. 4. Holotype of *Agrostis lacunis*.



Fig. 5. a—Spikelet of *Agrostis lacunis*. b—Spikelet of *Danthonia diemenica*. Scale lines = 5 mm.

TYPUS: Tasmania, Twisted Tarn, Mt Field National Park, 1110 m; Aquatic, shallow water with mud bottom; 1 Mar. 1983, A. M. Buchanan 1187 (HOLOTYPE: HO 93290; ISOTYPE: AD, MEL, NSW, CANB, CHR).

Erect or *geniculate*—ascending, glabrous perennial often rooting and branching from the lower nodes, 20–40 cm high, growing in water at the edge of tarns and lakes in highland areas. *Leaf-sheaths* ribbed, longer than the internodes, becoming loose, lower sheaths chartaceous, upper green or purplish; ligules up to 6 mm long, narrow-triangular; blades flat, up to 20 cm long by up to 2.5 mm wide, green or purplish, both surfaces finely ribbed, upper surface minutely scaberulous. *Culms* terete, smooth, minutely scaberulous below the panicle. *Panicle* up to 12 cm long by up to 7 cm wide, pyramidal, the branches 2–4 nate at the lowest node, binate at upper nodes, axis, branches and pedicels scabrous. *Spikelets* (2.5–) 2.75–4.0 mm long. *Glumes* subequal, sometimes the lower slightly longer, keels and lateral faces scabrous, purplish, margins membranous. *Lemma* (1.5–) 2–2.5 mm long, densely silky-hairy, apex 4-toothed, awn inserted at about the mid-point, 1.5–3.25 mm long, the smaller awns straight, slender, larger awns geniculate with a column up to 1.5 mm long; callus densely bearded. *Palea* a little shorter than the lemma, thinly membranous. *Rhachilla* bristle c. 0.5 mm long, hairy, the hairs often almost equalling the lemma. *Anthers* 0.6–0.8 mm long. (Figs. 4, 5a)

DISTRIBUTION:

Tasmania; Central Highlands and Mount Field, 850–1250 m altitude.

SPECIMENS EXAMINED:

Tasmania—Artists Pool, Cradle Mountain 30 Jan. 1982, A. M. Buchanan 856 (HO); Artists Pool, Cradle Mountain, 3 Jan. 1983, A. M. Buchanan 1073 (HO); Lake Rosa, February Plains, 23 Jun. 1983, A. Moscal 1523 (HO); Twisted Tarn, Tarn Shelf, 1 Mar. 1983, A. M. Buchanan 1194 (HO, BAA); 2 km S of Devils Den, 2 Mar. 1984, A. Moscal 6697 (HO, AD); Gun Lagoon, 13 Apr. 1986, P. Collier 1321 (HO); Lake Ewart, 7 Feb. 1987, A. M. Buchanan 10046 (HO).

ETYMOLOGY:

Lacunis, of pools, relating to the habitat.

The spikelets of this species resemble those of *A. meionectes* but the plant

differs from that species in being apparently perennial, in its purely aquatic habit, generally larger size with much longer leaves, which are always flat, culms which are up to 8-noded, branching and rooting from the lower nodes and occasionally (*Buchanan 10046*) producing fascicles of aerial shoots from the upper nodes. Panicle branches are less rigidly divaricate than those of *A. meionectes* and the lemma is more densely hairy.

DANTHONIA LAM. *et* DC.

Danthonia diemenica D. Morris *sp. nov.*

Gramen perenne caespitosum vel breviter rhizomatosum, usque ad 35 cm altum. *Vaginae* manifeste costatae, marginibus hyalinis, vaginae inferae pallidae, plus minusque nitidae, glabrae vel interdum pilosae; cilia ligularum c. 0.5 mm longa, pilis longioribus ad margines; laminae usque ad 25 cm longae, plerumque tenues involutaeque, raro planae et usque ad 3 mm latae, glabrae vel interdum pilosae apice conduplicato. *Culmi* tenues, 4–5-nodati. *Panicula* usque ad 5 cm longa, lanceolata vel ovata, usque ad 15 spiculas ferens. Spiculae (10–) 12–15 (–18) mm longae, 4–6 flores ferentes, apicibus aristarum exsertis. *Glumae* lanceolatae, acutae, subaequales, purpurascens, 3–5-nervatae. *Lemmatis* infimi corpus 3.0–4.5 mm longum, nitidum, 9 nervatum, leniter ad callum decrescens; segmentum rhachillae c. 0.5 mm longum; pili calli 1–2 mm longi; pili seriei inferae ad 3 mm longi, interdum sparsi vel interrupti, series superior superpositi; pili seriei superae ad 4 mm longi, 1–2 mm sub sinum inserti, portionem planam loborum lateralium plus minusque longitudine aequantes, lobi laterales 5–6 mm longi, setas 2–2.5 mm longas includentes; arista ad 11 mm longa, columna 3–4 mm longa laxae torta, castanea, seta plerumque semel bisve torta. *Palea* elliptica, 1.5–2 mm longior quam sinus, dimidio supero membranaceo hebeti, dimidio infero nitido, carinis marginibusque dense ciliolatis, plerumque caespitibus pilorum inter carinas marginesque infra medium. *Antherae* c. 1.25 mm longae, citrinae. *Caryopsis* obovata 1.75–2 mm longa.

HOLOTYPE: Tasmania, Ouse River—Wild Dog Plains, 1160 m; Streambanks—sandy alluvium till. Erosion sites; 7 Jan. 1983, *A. Moscal 1292* (HO 65782).

Tufted or shortly rhizomatous perennial up to 35 cm high, the culms usually greatly exceeding the tuft of basal leaves. *Leaf-sheaths* prominently ribbed, margins hyaline, lower sheaths pale, \pm shining, glabrous or occasionally pilose; ligule a ciliate rim, the cilia c. 0.5 mm long with a sparse or dense tuft of longer hairs up to 2.5 mm long at each margin; blades up to 25 cm long, usually fine and inrolled but rarely flat *in vivo* and up to 3 mm wide, glabrous or occasionally pilose, the apex folded. *Culms* slender, smooth, 4–5-noded. *Panicle* up to 5 cm long, lanceolate or ovate; axis, branches and pedicels scabrous or hispid, bearing up to 15 spikelets. *Spikelets* (10–) 12–15 (–18) mm long, 4–6-flowered, tips of the awns exserted. *Glumes* lanceolate, acute, subequal, purplish, margins pale or purplish, 3–5-nerved. *Body* of the lowest lemma 3.0–4.5 mm long, shining, 9-nerved, fairly broad, tapering gradually to the callus; rhachilla segment c. 0.5 mm long, callus hairs 1–2 mm long, overlapping the lower row of hairs, hairs of lower row sometimes sparse or interrupted, up to 3 mm long, overlapping the upper row, hairs of upper row up to 4 mm long, \pm equalling the flattened portion of the lateral lobes, inserted 1–2 mm below the sinus; lateral lobes 5–6 mm long including the 2–2.5 mm long setae; awn up to 11 mm long, the column 3–4 mm long, loosely twisted, chestnut brown, bristle usually once or twice twisted. *Palea* elliptical, exceeding the sinus by 1.5–2 mm, apex truncate or shallowly bifid, upper half membranous, dull, lower half firm, shining, keels densely and minutely ciliate, usually with sparse tufts of long hairs between keels and margins below the mid-point. *Anthers* c. 1.25 mm long, pale yellow. *Caryopsis* obovate, 1.75–2 mm long. (Figs. 5b, 6)

DISTRIBUTION:

Tasmania; predominantly in the Central Highlands but also North East, Ben Lomond, East Coast, Mt Wellington, South West, 480–1250 m altitude.



Fig. 6. Holotype of *Danthonia diemenica*.

SELECTED SPECIMENS EXAMINED (Total 60):

Tasmania—Saddle between Eldon Bluff and Dome Hill, 6 Feb. 1987, A. M. Buchanan 10043 (HO); Back Peak, 17 Jan. 1988, P. Collier 3094e (HO); Mt Wellington, 4 Jan. 1972, J. H. Hemsley 6707 (HO, K); Divide between Julian Lakes and Pillans Lake, 8 Jan. 1983, A. Moscal 1332 (HO, MEL); February Plains, 28 Jan. 1983, A. Moscal 1542 (HO); Wild Dog Tier, 9 Mar. 1984, A. Moscal 6798a (HO); Between Prince Albert's Throne and Lake Ila, 17 Mar. 1984, A. Moscal 7098 (HO); Dunning Rivulet, 28 Feb. 1986, A. Moscal 12525 (HO); Tower Hill, East Tower, 13 Feb. 1980, M. G. Noble 29051 (HO); Western Mountains, Dec. 1908, L. Rodway s.n. (HO 27935); South slope of the southern hill of Sabrina Hills, 8 km SE of Bothwell, 15 Dec. 1986, D. Ziegler 47 (HO).

ETYMOLOGY:

Diemenica, in reference to Van Diemens Land, the early name for Tasmania.

D. diemenica has in the past been confused with *D. tenuior* and *D. caespitosa*, differing from the former in having a shorter callus, longer rachilla segment and a palea exceeding the lemma sinus by 1.5–2 mm; differing from the latter in the shorter callus, shorter lateral lobes and in having fewer florets per spikelet. Differences between the species are summarised in the following table:

	<i>D. tenuior</i>	<i>D. caespitosa</i>	<i>D. diemenica</i>
Callus	1–1.5 mm	0.75–1.5 mm	0.5 mm
Rachilla segment	0	0	0.5 mm
Lemma lobes	7–10 mm	8–13 mm	5–6 mm
Florets per spikelet	4–6	7–9	4–6
Amount by which the palea exceeds the lemma sinus	up to 1 mm	0.75–1.5 mm	1.5–2 mm

Danthonia nitens D. Morris *sp. nov.*

Gramen perenne, caespitosum, usque ad 25 cm altum. *Vaginae* glabrae vel raro sparsim pilosae, costatae; cilia ligularum 0.5 mm longa caespitibus pilorum ad 2 mm longis ad margines; laminae foliorum inferiorum usque ad 9 cm longae, involutae vel planae, usque ad 1.5 mm latae, glabrae vel interdum pilosae. *Culmi* plerumque 3-nodati, laeves, subtiliter costati infra nodos, scabri-pilosi infra paniculam. *Inflorescentia* racemosa vel panicula deminuta 0.9–3.5 cm longa 2–4 (–8) spiculas ferens; spiculae ad nodos omnes solitariae vel, in plantis majoribus, nodi inferi ramum solitarium spiculis duabus efferentes; axis et rami et pedicelli pilosi, pilis densioribus infra glumas. *Spiculae* 4–6 flores ferentes, flore terminali saepe sterili, apicibus aristarum lemmatum breviter exsertis. *Glumae* subaequales, 6.5–7.5 mm longae × 2.5 mm latae, lanceolatae apicibus obtusis; gluma inferior 5–7-nervata, gluma superior 5(–7) nervata. *Lemma* ellipticum, corpore 2.25–3.25 mm longo, nitens, 7-nervatum, glabrum, praeter caespitem pilorum aliquantum sparsum c. 1 mm longum ad ambo margines ad medium et caespitem minorem ad ambo margines supra callum; lobi laterales angusti ubique 1.25–2 mm longi, abrupte ad apicem acutum vel leniter ad setam brevem decrescentes arista 3–4 mm longa, columna c. 1 mm longa, mellea; callus pilis densis c. 1 mm longis. *Palea* lanceolata-elliptica vel oblanceolata-elliptica, sinum lemmatis excedens, brevior quam portio plana loborum lateralium, nitens, apice truncato, breve bifido, carinis ciliatis in triente superno. *Antherae* 0.3–0.6 mm longae. *Caryopsis* c. 1.5 mm longa.

HOLOTYPE: Tasmania, Dublin Forest Block, 21 Jan. 1979, H. Fletcher s.n. (HO 30982).

Tufted perennial up to 25 cm high. *Leaf-sheaths* glabrous or rarely sparsely pilose, ribbed, lower sheaths pale, shining or dull; ligule of cilia up to 0.5 mm long with tufts of longer hairs up to 2 mm long at each margin; blades of basal leaves up to 9 cm long, involute or flat and up to 1.5 mm wide; glabrous or occasionally pilose. *Culm* usually 3-noded, smooth, finely ribbed below the nodes, scabrous-pilose below the panicle. *Inflorescence* racemose or a reduced panicle 0.9–3.5 cm long bearing 2–4 (–8) spikelets; spikelets solitary at each node or in larger plants the lower nodes producing a single branch bearing two spikelets; axis, branches and pedicels pilose, the hairs denser below the glumes. *Spikelets* 4–6 flowered, the terminal floret often sterile, tips of lemma awns shortly exserted. *Glumes* subequal, 6.5–7.5 mm long × 2.5 mm broad, lanceolate, apex obtuse, lower glume 5–7 nerved, upper 5 (–7) nerved. *Lemma* elliptical, body 2.25–3.25 mm long, shining, 7-nerved, glabrous



Fig. 7. Holotype of *Danthonia nitens*.

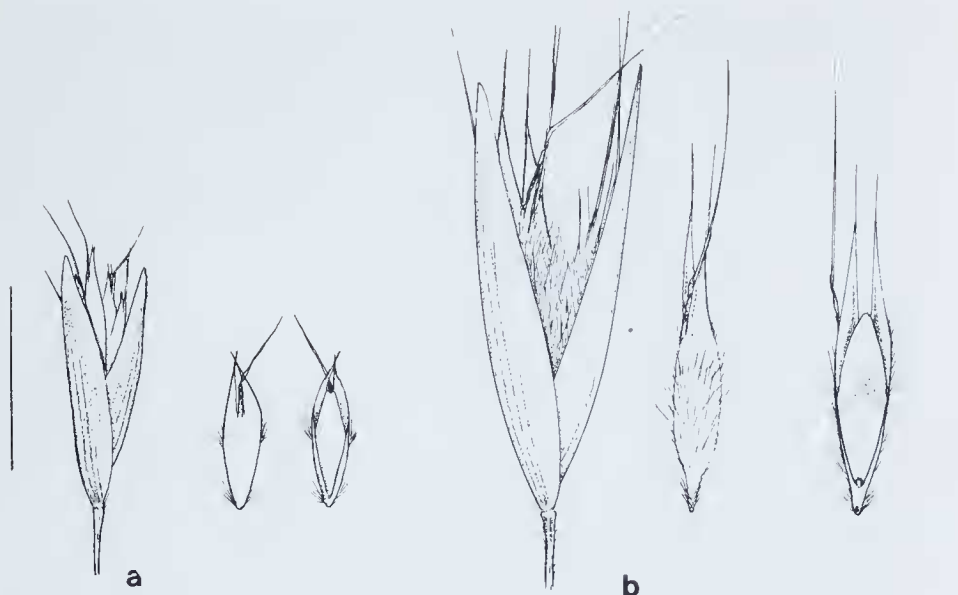


Fig. 8. a—Spikelet of *Danthonia nitens*. b—Spikelet of *Danthonia popinensis*. Scale lines = 5 mm.

except for a rather sparse tuft of hairs c. 1 mm long on each margin at about the mid-point and a smaller tuft on each margin above the callus; lateral lobes narrow, 1.25–2 mm long overall, tapering abruptly to an acute apex or more gradually to a short seta; awn 3–4 mm long, the column c. 1 mm long, honey brown; callus hairs dense, c. 1 mm long. *Palea* lanceolate-elliptic to oblanceolate-elliptic, exceeding the sinus, shorter than the broad portion of the lateral lobes, shining, apex truncate, shortly bifid, keels ciliate in the upper third. *Anthers* 0.3–0.6 mm long. *Caryopsis* c. 1.5 mm long, obovoid. (Figs. 7, 8a)

DISTRIBUTION:

Tasmania; Central Highlands, grass-heathlands and open woodlands, mostly between 1000 and 1200 m altitude.

SPECIMENS EXAMINED:

Tasmania—Franklin River, Lyell Highway, 23 Jan. 1949, S. T. Blake 18406 (HO, BRI); Near Lake St Clair, 5 Jan. 1977, R. Mason s.n. (HO 35755, CHR 308847); Billop Bluff, N of Arthurs Lake, 18 Feb. 1981, A. Moscal s.n. (HO 40221); Rushcroft Creek, 21 Feb. 1984, A. Moscal 6348 (HO); Smiths Tops, 21 Feb. 1984, A. Moscal 6367 (HO); 1.5 km W of Norths Hill, 27 Feb. 1984, A. Moscal 6530 (HO); Ouse River, Little Split Rock, 28 Feb. 1984, A. Moscal 6576 (HO).

ETYMOLOGY:

Nitens, shining, in reference to the shining lemma.

Danthonia nitens appears most closely related to *D. nivicola* from which it differs in having less stiffly erect culms, the uppermost node usually exerted above the basal tuft of leaves, pilose panicle branches, prominently nerved glumes and the shining elliptical lemma with hair-tufts only at the margins.

Danthonia popinensis D. Morris sp. nov.

Gramen perenne caespitosum, glabrum, usque ad 45 cm altum. *Vaginae* foliorum inferiorum pallidae, \pm nitidae, costatae, internodiis longiores vel breviores; *vaginae* foliorum superiorum costatae internodiis breviores; *laminae* foliorum inferiorum planae, minimum basi, usque ad 15 cm longae \times usque ad 2 mm latae, superficie adaxiali subtiliter costata, costis minute scaberulis, marginibus carinisque in dimidio superiore scaberulis; *laminae* foliorum superiorum tenuiores, involutae. *Culmi*

laeves, subtiliter costati, nodis purpurei. *Panicula* usque ad 8 cm longa, lanceolata vel linearis, viridis, ramis pedicellisque scabris vel hispidis. *Spiculae* 13–14 mm longae, aristas excludentes quas per 3–4 mm exsertuntur, 5–6 floratae. *Glumae* subaequales, lanceolatae-acutae, virides, marginibus latis hyalinis, gluma infera c. 14 mm longa, 7-nervata, gluma supera c. 13 mm longa, 5-nervata. *Corpus lemmatis* infimi 7-nervatum, 4–4.5 mm longum, callo stipitato 1–1.5 mm longo dense barbato incluso, serie infera pilorum ad seriem superom attigenti; serie supera pilorum c. 4 mm longa, infra sinum c. 1 mm inserta, area inter series pilis dispersis c. 2 mm longis; caespitibus densis pilorum ad ambo margines; lobi laterali c. 7 mm long, portione plana longitudine setam \pm aequans; arista c. 12 mm longa, columna c. 2.5 mm longa, arcte torta, brunnea. *Palea* c. 5 mm longa, oblanceolata, apice bifido, sinum lemmatis 2.5 mm excedens, carinis ciliatis, serie pilorum usque ad 2.5 mm longos secus ambo latera inter carinam marginemque in inferis 2/3. *Antherae* c. 1 mm longae. *Caryopsis* c. 2 mm longa obovata.

TYPUS: Tasmania 0.5 km N of Kempton, opposite 'Mood Food', Roadside, 25 Apr. 1985, *D. I. Morris* 8556 (HOLOTYPE: HO 92651; ISOTYPI HO,AD,NSW).

Tufted glabrous perennial up to 45 cm high. *Lower* leaf-sheaths pale, \pm shining, ribbed, shorter or longer than the internodes, upper leaf sheaths ribbed, shorter than the internodes; blades of lower leaves flat, at least at the base, up to 15 cm long by up to 2 mm wide, abaxial surface prominently ribbed, adaxial surface finely ribbed, the ribs minutely scaberulous, margins and keel scabrous in the upper half, upper leaves finer, inrolled. *Culms* smooth, finely ribbed; nodes purple. *Panicle* up to 8 cm long, lanceolate to linear, pale green, branches and pedicels scabrous to hispid. *Spikelets* 13–14 mm long excluding the awns which are exerted for 3–4 mm, 5–6 flowered. *Glumes* subequal, lanceolate-acute, green with wide hyaline margins, lower glume c. 14 mm long, 7-nerved, upper c. 13 mm long, 5-nerved. *Body of lowest lemma* 7-nerved, 4–4.5 mm long including the stipe-like, 1–1.5 mm long, densely bearded callus; lower row of hairs reaching to the upper row, upper row of hairs c. 4 mm long, inserted c. 1 mm below the sinus, area between the two rows with scattered hairs c. 2 mm long, dense tufts at each margin at the level of the upper and lower rows of hairs; lateral lobes c. 7 mm long, the flattened portion and the setae \pm equal; awn c. 12 mm long, column c. 2.5 mm long, tightly twisted, brown. *Palea* c. 5 mm long, oblanceolate, apex bifid, exceeding the sinus of the lemma by c. 2.5 mm; keels ciliate throughout; a row of hairs up to 2.5 mm long down each side between keel and margin in the lower two thirds. *Anthems* c. 1 mm long. *Caryopsis* c. 2 mm long, obovate. (Figs. 8b, 9)

DISTRIBUTION:

Tasmania; Midlands.

SPECIMENS EXAMINED:

Tasmania—0.5 km N of Kempton on Midlands Highway, 23 Mar. 1985, *D. I. Morris* 8541 (HO); 1/2 km N of Kempton, opposite 'Mood Food', 16 Jan. 1987, *D. I. Morris* 86162 (HO,MEL,NSW).

ETYMOLOGY:

From *popina*, an eating place. The grass was first found in March 1985 when the author, heading north from Hobart on a collecting trip with Dr. Winifred Curtis, stopped for petrol at a wayside garage and cafe trading under the name 'Mood Food'. For some months the specimens were stored as '*D. moodfoodensis*', a name perhaps too frivolous for publication and the epithet *popinensis* was selected as an acceptable alternative.

Danthonia popinensis resembles *D. monticola* in having scattered hairs between the upper and lower rows of hairs on the lemma but differs in having longer glumes, the lower of which is 7-nerved, the upper 5-nerved, body of the lemma 4–4.5 mm long and the upper row of hairs up to 4 mm long. It differs from *D. linkii* var. *fulva* in being generally a smaller plant and in having the hairs on the back of the lemma scattered between a lower row of hair-tufts c. 2 mm long and an upper row c. 4 mm long whereas in *D. linkii* var. *fulva* the lower row of hair-tufts is absent and the hairs on the back are evenly scattered, grading into the upper row of hairs which are c. 5 mm long. The inter-carinal area of the palea is glabrous in *D. popinensis* but is hairy in *D. linkii* var. *fulva*.

Danthonia remota D. Morris *sp. nov.*

Gramen perenne laxe caespitosum usque ad 20 cm altum. *Vaginae* foliorum laeves, manifeste costatae, vaginae foliorum inferorum pallidae \pm nitidae; ligulae ciliatae, usque ad 1 mm longae; laminae usque ad 4 cm longae, arcte conduplicatae, filiformes, laeves, apice acuto. *Culmi* tenues, erecti, laeves. *Panicula* ovata usque ad 3 cm longa, 2-7 spiculas ferens, axe et ramis et pedicellis hispidis vel pilosis. *Spiculae* 9-12 mm longae, 4-5-floratae, apicibus aristarum exsertis. *Glumae* longitudine aequales vel superae quam inferae parum breviores, lanceolatae, obtusae; gluma infera 9-13-nervata, gluma supera 7-nervata. *Lemmata* oblanceolata, corpore lemmatis infimi c. 3 mm longo, callo usque ad 0.75 mm longo, barbato, pilis ad seriem inferam pilorum lemmatis attigentibus; serie infera pilorum ad 2-4 caespites sparsos reductis, caespitibus longioribus ad margines; series supera pilorum c. 1.5 mm longa, sparsissima vel ad 2 caespites reducta, caespitibus longioribus et densioribus ad margines c. 0.75 mm infra sinum inserta; lemmate aliquando purpureo-fasciato infra sinum; lobi laterales c. 6 mm longi, portionibus planis 2.5 mm longis, marginibus latis hyalinis, gradatim ad setas angustatis vel ad juncturam minute lobatis; arista 7.5-9 mm longa, columna 2.5 mm longa, brunnea, torta. *Palea* oblanceolata, 3.5-4 mm longa, marginibus superne ciliolatis, area dorsali \pm nitida, apice acuto vel truncato, breviter bifido vel irregulariter et oblique trilobato. *Antherae* c. 0.75 mm longae. *Caryopsis* c. 1.5 mm longa.

HOLOTYPE: Tasmania, Summit area of Hibbs Pyramid, 4 Feb. 1984, A. M. Buchanan (HO 91392).

Loosely tufted glabrous *perennial* up to 20 cm high from a tuft of basal leaves. *Leaf-sheaths* smooth, prominently ribbed, lower sheaths pale, \pm shining; ligule ciliate, up to 1 mm long, blades up to 4 cm long, tightly infolded, smooth, filiform, apex sharply pointed. *Culm* slender, erect, smooth. *Panicle* ovate, up to 3 cm long, bearing 2-7 spikelets, axis, branches and pedicels hispid to pilose. *Spikelets* 9-12 mm long, 4-5 flowered, tips of awns exserted. *Glumes* equal or subequal with the lower slightly longer, lanceolate, obtuse, lower glume 9-13-nerved, upper glume 7-nerved. *Body of lowest lemma* c. 3 mm long, oblanceolate, callus up to 0.75 mm long, bearded, the hairs reaching to the lower row of callus hairs; lower row reduced to 2-4 sparse tufts with longer tufts at the margin; upper row of very sparse tufts or reduced to 2 sparse tufts with longer tufts at the margin; upper row of very sparse tufts or reduced to 2 sparse dorsal tufts with longer and denser tufts at the margin, inserted c. 0.75 mm below the sinus, the hairs c. 1.5 mm long; sometimes a band of purple coloration across the body below the sinus, paling with age; lateral lobes c. 6 mm long, the flattened portion c. 2.5 mm long, with wide hyaline margins, tapering gradually to the setae or minutely lobed at the junction; awn 7.5-9 mm long, column 2.5 mm long, brown, twisted. *Palea* 3.5-4 mm long, oblanceolate, margins ciliolate above, dorsal area \pm shining, apex acute or truncate, shortly bilobed or irregularly and obliquely trilobed. *Anthers* c. 0.75 mm long. *Caryopsis* c. 1.5 mm long. (Figs. 10, 11a)

DISTRIBUTION:

Tasmania; known only from the type collection from the summit of Hibbs Pyramid, a small dolorite island north of Point Hibbs on the West Coast, at an altitude of 70 m and from a second collection from the same site, Dec. 1988, N. Brothers *s.n.* (HO 113101, MEL, NSW).

ETYMOLOGY:

Remota, distant, far off, relating to the isolated locality of Hibbs Pyramid.

The species appears most closely related to *D. pilosa* from which it differs in being completely glabrous, having spikelets 4-5 flowered, lower glume 9-13-nerved and an awn 7.5-9 mm long.

DEYEUXIA CLARION EX P. BEAUV.

Deyeuxia apsleyensis D. Morris *sp. nov.*

Gramen perenne laxe caespitosum usque ad 90 cm altum. *Vaginae* foliorum internodiis breviores, virides vel purpurascens, vaginae foliorum inferorum pilosae, foliorum suprorum \pm glabrae, \pm retrorse scabrae; ligulae 1 (-2) mm longae, obtusae, dorsalis hirsutae, ciliolatae; laminae foliorum

91592



Fig. 10. Holotype of *Danthonia remota*.



Fig. 11. a—Spikelet of *Danthonia remota*. b—Spikelet of *Deyeuxia aysleyensis*. Scale lines = 5 mm.

basalium et foliorum surculorum vegetativorum usque ad 35 cm longae \times usque ad 1.5 mm latae ubi complanatae, arcte conduplicatae vel involutae, pilosae; laminae foliorum culmorum gradatim minores, foliorum summorum saepe minus quam 1 mm longae, glabrae. *Culmi* tenues, laeves, sub nodis scaberuli vel aliquando dense pilosi, internodis saepe purpurascentibus, nodis purpurascentibus, glabris. *Panícula* laxa vel laxe contracta, usque ad 14 cm longa, ramis usque ad 4.5 cm longis; rhachis et rami et pedicelli scabri, viridi vel purpurascentes. *Spiculae* 5.5–6.5 mm longae, lemmate glumas aequante vel excedenti. *Glumae* lanceolatae, acutae vel apiculatae, aequales vel subaequales, laeves vel parce scaberulae, carinis dense scaberulis; gluma infera 4.5–5 mm longa, gluma supera 5–6.5 mm longa. *Callus* barbatus pilis usque ad 1.5 mm longis. *Lemna* 5–6.5 mm longum, lanceolatum, cartilagineum, scaberulum, 5-nervatum, apice breviter bidentato, arista 7.5–8 mm longa in triente basali lemmatis inserta, geniculata, columna torta lemma \pm aequanti. *Palea* lemma aequans vel parum excedens, carinis ciliolatis. *Segmentum* rhachillae c. 1.5 mm longum, pilosum, pilis usque ad 1.5 mm longis. *Antherae* 2 mm longae. *Caryopsis* c. 3 mm longa.

TYPUS: Tasmania, Apsley River area, north of Apsley Gorge, 3 Feb. 1988, *F. Duncan*, s.n. (HOLOTYPE HO 111147; ISOTYPE NSW).

Loosely tufted erect *perennial* up to 90 cm high. *Leaf-sheaths* shorter than the internodes, green or purplish, lower sheaths pilose, upper sheaths \pm glabrous, \pm retrorsely scaberulous; ligules 1 (–2) mm long, rounded, hairy on the back, ciliate; blades of basal leaves and those of vegetative shoots up to 35 cm long \times up to 1.5 mm wide when flattened; tightly folded or inrolled, pilose; blades of culm leaves progressively smaller, the uppermost often less than 1 cm long, glabrous. *Culms* slender, smooth, scaberulous or sometimes densely pilose below the nodes, lower internodes often purplish, nodes purple, glabrous. *Inflorescence* an open or loosely contracted panicle up to 14 cm long, branches up to 4.5 cm long, rhachis, branches and pedicels scabrous, green or purplish. *Spikelets* 5.5–6.75 mm long, the lemma equalling or exceeding the glumes. *Glumes* lanceolate, acute to apiculate, unequal to subequal, smooth or sparingly scaberulous, keels densely scaberulous, lower glume 4.5–5 mm long, upper 5–6.5 mm long. *Callus* bearded, the hairs up to 1.5 mm long. *Lemna* 5–6.5 mm long, lanceolate in outline, firm, scaberulous, 5-nerved, apex shortly 2-toothed; awn 7.5–8 mm long inserted in the basal 1/3 of the lemma, geniculate, column twisted, \pm equalling the lemma. *Palea* equalling or slightly exceeding the lemma, keels ciliate. *Rhachilla* segment c. 1.5 mm long, hairy, the hairs up to 1.5 mm long. *Anthers* 2 mm long. *Caryopsis* c. 3 mm long. (Figs. 11b, 12)

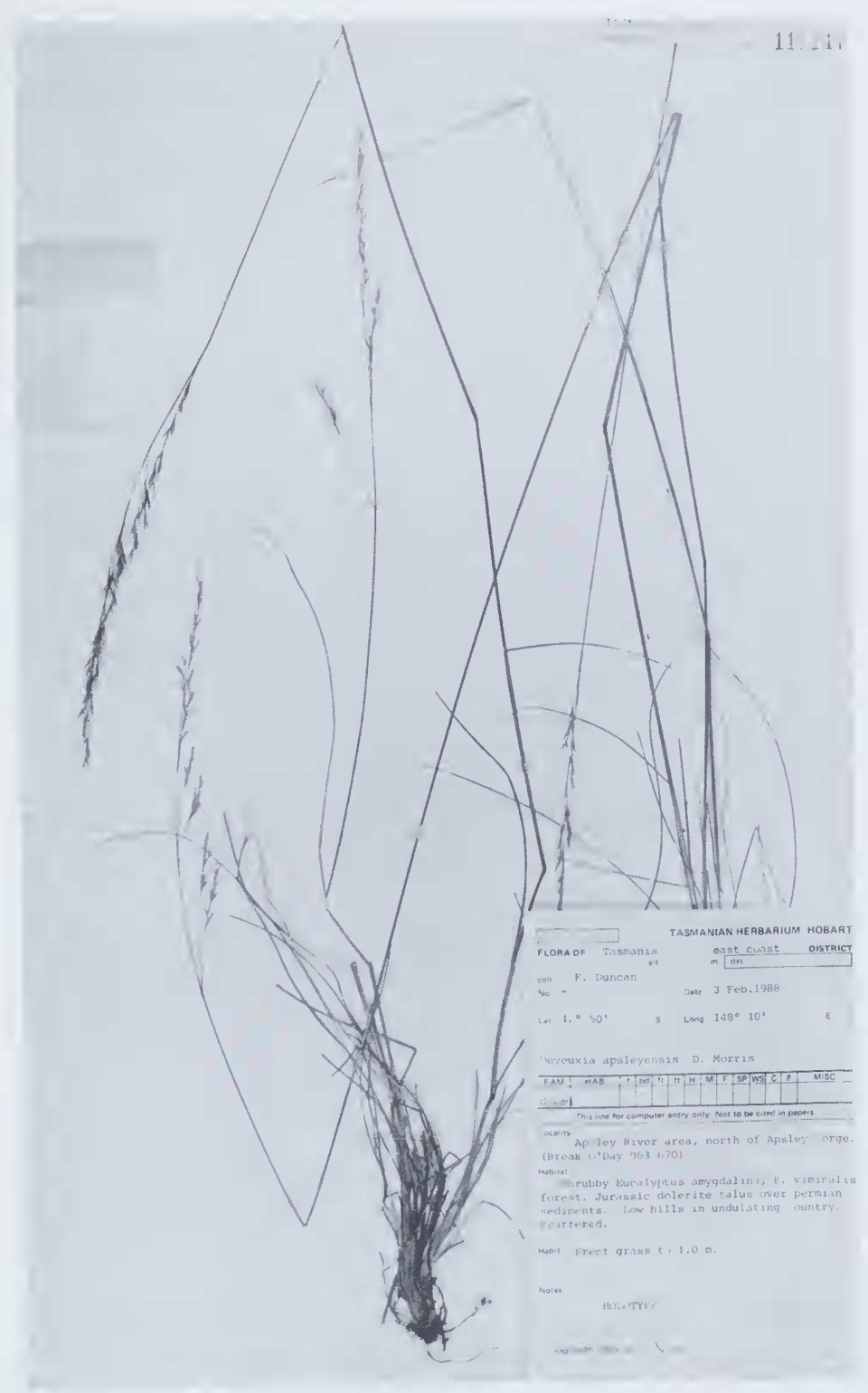


Fig. 12. Holotype of *Deyeuxia apseyensis*.

DISTRIBUTION:

Tasmania; East coast, valley of the Apsley River in *Eucalyptus amygdalina*—*E. viminalis* forest in undulating low hills.

SPECIMENS EXAMINED:

Tasmania—Ridge 3 km N of Apsley River Gorge, 9 Jan. 1988, *F. Duncan s.n.* (HO 111250); Apsley river catchment, W of Possum Creek, 16 Mar. 1988, *F. Duncan s.n.* (HO 111249).

D. apseyensis resembles *D. monticola* in having the lemma awn inserted in the basal 1/3 and a hairy rhachilla segment but has a larger spikelet, an open or loosely contracted panicle and pilose leaves.

Deyeuxia innominata* D. Morris *sp. nov.

Gramen perenne, laxum vel aliquantum dense caespitosum, plerumque usque ad 25 cm altum autem in habitationibus salutarissimum ad 60 cm attingens. *Vaginae* foliorum non profunde costatae, marginibus membranaceis ad ligulam connexis; ligulae membranaceae, truncatae, 2.0–2.5 mm longae; laminae usque ad 8 (–15) cm longae, conduplicatae vel involutae, tenues et flexiles vel aliquantum rigidae, saepe arcuatae, laeves, glabrae vel interdum ad superficiem abaxialem setosae, costis ad superficiem adaxialem hispidulis vel glabris. *Culmi* tenues, plerumque quam folia basalia multi longiores, laeves vel interdum antrorse scaberuli infra paniculam. *Paniculae* 2–8 cm longae, laxae contractae, ramis pedicellisque scabris, ramis basalibus saepe nudis per 1 cm supra basin. *Spiculae* 2–3.5 mm longae, purpurascens vel subvirides. *Glumae* subaequales, gluma supera plerumque quam gluma inferior parum longior, acutae, carinis in dimidio supero scaberulis. *Lemma* (2.0–) 2.25–3.0 mm longum parum brevius vel parum longius quam glumae, 5-nervatum, nervis obscuris vel prominentibus, parum induratum, cum vel sine arista. *Arista* parvula, recta, subterminalis, plerumque lemmati non excedens autem aliquando ad 1 mm attingens. *Pili* calli densi, plerumque ad dimidium lemmatis attigentes vel aliquando parum longiores. *Palea* hyalina plerumque quam lemma c. 0.5 mm brevior, carinis viridibus, non ciliatis. *Segmentum* rhachillae c. 1 mm longum, plumosum, pilis ± palea aequantibus. *Antherae* 0.5–0.75 mm longae. *Caryopsis* elliptica, c. 1.5 mm longa.

TYPUS: Tasmania, Wurragurra Creek, 29 Jan. 1983, *A. Moscal 1569*, (HOLOTYPE: HO 62754; ISOTYPE NSW).

Erect loosely or occasionally somewhat densely tufted *perennial*, usually up to 25 cm high but in very favourable situations reaching 60 cm. *Leaf-sheaths* shallowly ribbed, margins membranous, merging with the ligule; ligule membranous, truncate 2–2.5 mm long; blades up to 8 (–15) cm long, folded or inrolled, slender and flexible, somewhat stiff, often arcuate, smooth, glabrous or sometimes setose on the abaxial surface, the ribs on the adaxial surface glabrous or hispidulous. *Culms* slender, usually exerted well beyond the basal leaves, smooth or sometimes antrorsely scaberulous below the panicle. Panicle 2–8 cm long, loosely contracted, narrowly elliptical to linear in outline, branches and pedicels scabrous, basal branches often bare at the base for 1 cm or more. *Spikelets* 2–3.5 mm long, purplish or pale green. *Glumes* subequal, the upper usually slightly the longer, acute, keels scaberulous in the upper half. *Lemma* slightly shorter than, to slightly longer than the glumes, 2.25–3.0 mm long, 5-nerved, the nerves obscure or prominent, slightly indurated, with or without a small straight subterminal awn usually not exceeding the lemma but occasionally up to 1 mm long; callus hairs dense, usually half as long as the lemma, occasionally more. *Palea* hyaline, usually about 0.5 mm shorter than the lemma, keels green, not ciliate. *Rhachilla* segment about 1 mm long, plumose, the hairs ± equalling the palea. *Anthers* 0.5–0.75 mm long. *Caryopsis* elliptical, c. 1.5 mm long. (Figs 13, 14)

DISTRIBUTION:

Tasmania; Central Highlands, Ben Lomond, Mt Field, Mt Wellington, South West, East Coast, West Coast, 550 m to 1300 m, alpine moorland, boulder fields, sedge-grasslands, heaths; Victoria; Nunniong Plateau, Cobberas Mountains, Baws Baws, The Bluff, Mt Buffalo, Bogong High Plains; New South Wales; subalpine areas in the Kosciuszko region, Kiandra, Southern Tablelands, Northern Tablelands; A.C.T. Mt Gingera, Mt Bimberi.



Fig. 13. Holotype of *Deyeuxia innominata*.



Fig. 14. Spikelet of *Deyeuxia innominata*. Scale = 5 mm.

SELECTED SPECIMENS EXAMINED (Total 36):

Tasmania—Wombat Moor, Mt Field National Park, 19 Jan. 1979, *D. I. Morris* (HO); Pool of Bethesda, 18 Jan. 1983, *A. Moscal 1418* (HO); Lake Skinner, 19 Mar. 1983, *A. Moscal 2076* (HO); Liffey Bluff, 29 Mar. 1983, *A. Moscal 2202* (HO); Mackenzies' Tier, 22 Feb. 1984, *A. Moscal 6444* (HO); Kermandie Plain, 11 May 1985, *A. Moscal 10890* (HO); Mt Wellington, 6 Mar. 1974, *D. & A. Ratkowsky s.n.* (HO 10437); Top of Mt Mawson, 5 Apr. 1964, *J. E. S. Townrow s.n.* (HO 107849); Path to Arve Falls, Hartz Moor, 20 Jan. 1967, *J. E. S. Townrow s.n.* (HO 107488).

Victoria—The Bluff, 22 Jan. 1981, *N. G. Walsh 953* (MEL).

ETYMOLOGY:

Innominata, unnamed. The species has been recognised but unnamed for many years.

The species has been referred to in the following publications:

Burbidge, N. T. & Gray, M., *Flora of the A.C.T.*, 47 (1970) as *D. sp.*

Thompson, J., *A Key to the Plants of the Subalpine and Alpine Zones of the Kosciusko Region: Telopea* 2(3), 240 (1981) as *D. sp.*

Jacobs, S. W. L. and Pickard, J., *Plants of New South Wales* 42 (1981) as *D. sp. aff. parviseta*.

Wheeler, D. J. B., Jacobs, S. W. L., & Norton, B. E., *Grasses of New South Wales*, 159 (1982) as *D. sp. aff. parviseta*.

Forbes, S. J. & Ross, J. H., *A Census of the vascular Plants of Victoria, Second Edition*, 22 (1988) as *D. sp.*

This species is closely related to *D. affinis* M. Gray from which it differs in

having glumes which are acute as compared to the acuminate or mucronate glumes of *D. affinis*, the lemma is less conspicuously acute, the callus hairs are usually not more than half as long as the lemma and the awn, although occasionally up to 1 mm long does not usually exceed the lemma and may be absent. In N.S.W. and Victoria it occurs in subalpine areas whereas *D. affinis* is mainly alpine, above 1940 m. The spikelets of *D. innominata* resemble those of *D. parviseta* var. *boormanii* Vick. but in the latter species the whole plant is much larger with longer, flat leaves and the panicle 12–20 cm long with spreading branches. Tasmanian material held at NSW has been compared with material from Victoria and N.S.W. by Mrs J. Thompson who agrees that Tasmanian plants and those from the mainland are conspecific (pers. comm.).

PENTAPOGON R. Br.

When Brown (1810) created the genus *Pentapogon* he quoted *Agrostis quadrifida* Labill. as a synonym for his single species *Pentapogon billardieri* R. Br. Bentham (1877) used Brown's *Pentapogon billardieri* and created the variety *parviflorus*. Baillon (1893) published the new combination *Pentapogon quadrifidus* based on *Agrostis quadrifida* Labill. but overlooked Bentham's variety. As the varieties are quite distinct it is necessary to retain variety *parviflorus* and to create the new combination.

Pentapogon quadrifidus* (Labill.) Baillon var. *parviflorus* (Benth.) D. Morris, *comb. nov.

BASIONYM: *Pentapogon billardieri* R.Br. var *parviflorus* Benth., Flora Australiensis 7: 573 (1877). HOLOTYPE: Recherche Bay, C. Stuart (K).

DISTRIBUTION:

Tasmania; East Coast, Mt Wellington, Central Highlands, South West, sea level to c. 1200 m, herb-grasslands, heath, alpine shrubberies, cliff faces, rock crevices, stream banks, cushion plant communities. Most common in the Central Highlands and South West. Apparently more common than *Pentapogon quadrifidus* var. *quadrifidus* in Tasmania.

POA L.

Poa jugicola* D. Morris *sp. nov.

Gramen perenne dense caespitosum vel laxe caespitosum et rhizomata effusa et stolones breves ascendentes emittens. *Folia* plerumque basi. *Vaginae* foliorum pallidae, plus minusque nitidae vel fuscae, pubescentes vel glabrescentes, vaginae superiores glabrae vel basi parce pubescentes. *Ligulae* 0.5–2.0 mm longae, truncatae vel obtusae, ad apices ciliolatae postice pubescentes. *Laminae* foliorum inferiorum usque ad 35 cm longae, tenues, molles, involutae, angulosae, glabrae vel parce pilosae, apicibus cucullatis, scabrellis. *Culmi* usque ad 95 cm alti, graciles, teretes, 2-nodati, folia multum excedens, nodis glabris. *Panicula* 10–25 cm longa, laxe contracta vel tandem effusa, rhachis angulosa, scabra; rami capillares, scabri, spiculae in extremitatibus ramulorum, pedicelli scabri. *Spiculae* 2–5-floratae, 4–7 mm longae, compressae, viridescens vel purpurascens. *Glumae* subaequales, c. 3 mm longae, acutae vel subacutae, gluma inferior 1–3-nervata, gluma superior 3-nervata, carinis modice vel valde scabris, paginis lateralibus glabris vel scaberulis, marginibus hyalinis. *Aranea* copiosa vel exigua vel obsoleta. *Lemma* 3.5–4.5 mm longum, oblongum vel lanceolatum, obtusum, deorsum ad carinam villosum, sursum scaberulum, nervis marginalibus deorsum villosis, nervis et internervis aliquando sursum scaberulis. *Palea* ad carinas sursum scabra vel scabro-ciliolata, deorsum laevis. *Antherae* c. 2.5 mm longae, flavescens vel purpurascens.

TYPUS: Tasmania, Quamby Bluff, 6 Mar. 1986, A. Moscal 12591, (HOLOTYPE: HO 96575; ISOTYPUS NSW).

Perennial, densely tufted or loosely tufted with spreading rhizomes and short ascending stolons. *Leaves* mostly basal. *Leaf-sheaths* pale and more or less shining or dull brown, pubescent or glabrous, upper sheaths glabrous or sparsely pubescent



at the base. *Ligules* 0.5–2.0 mm long, truncate or obtuse, apex ciliolate, pubescent on the back. *Blades* of basal leaves up to 35 cm long, fine, soft, involute, angular, glabrous or sparsely pilose, apices cucullate, scaberulous. *Culm* up to 95 cm high, slender, terete, 2-noded, greatly exceeding the leaves, nodes glabrous. *Panicle* 10–25 cm long loosely contracted or spreading later, rhachis angular, scabrous, branches capillary, scabrous, the spikelets borne towards the ends of the branches, pedicels scabrous. *Spikelets* 2–5-flowered, 4–7 mm long, compressed, green or purplish. *Glumes* subequal, c. 3 mm long, acute or subacute, the lower 1–3-nerved, the upper 3-nerved, keels sparsely or strongly scabrous, lateral faces glabrous or scaberulous, margins hyaline. *Web* copious, sparse or obsolete. *Lemma* 3.5–4.5 mm long, oblong-lanceolate, obtuse, keels villous below, scaberulous above, marginal nerves villous below, nerves and internerves sometimes scaberulous above. *Palea* with keels scabrous or scabrous-ciliate above, smooth below. *Anthers* c. 2.5 mm long, yellow or purplish. (Fig. 15)

DISTRIBUTION:

Tasmania; Central Highlands and Midlands above 890 m. Among boulders or on dolerite outcrops in subalpine *Nothofagus cunninghamii* forest.

SPECIMENS EXAMINED:

Tasmania—Quamby Bluff, 2 Mar. 1986, A. Moscal 12546b (HO); Quamby Bluff, 6 Mar. 1986, A. Moscal 12592 (HO); Nells Bluff, 14 Mar. 1986, A. Moscal 12686 (HO); Higgs Track, Great Western Tiers, 27 Jan. 1988, D. Ziegeler s.n. (HO).

ETYMOLOGY:

Jugicola, dwelling in mountain ranges.

P. jugicola is distinguished by the presence of rhizomes, a rather lax tussock, fine soft glabrous leaves and a panicle usually looser and more spreading than that of *P. labillardieri*. The spikelets closely resemble those of *P. labillardieri*.

***Poa poiformis* (Labill.) Druce var. *ramifer* D. Morris var. nov.**

A var. *Poa poiformis* (Labill.) Druce var. *poiformis* nodis inferis ramiferis et vaginis internodiisque saepe purpurascens differt.

TYPUS: Tasmania, Southport Island, NE of Southport Bluff, 3 Dec. 1980, N. Brothers s.n. (HOLOTYPE: HO 36816; ISOTYPE MEL).

Differs from *Poa poiformis* var. *poiformis* in branching from the lower nodes and in the sheaths and internodes being often purple. The culm is frequently up to 2.5 mm in diameter at the lower internodes. In one specimen (HO 94717) a non-flowering culm is 13-noded. (Fig. 16)

DISTRIBUTION:

Tasmania; shores and offshore islands on the East Coast and Furneaux Group, Victoria.

SPECIMENS EXAMINED:

Tasmania—Sterile Island, 8 km E of Recherche Bay, 3 Dec. 1972, N. Brothers s.n. (HO 36894); Nine Mile Beach, near Point Bagot, 29 Dec. 1981, A. M. Buchanan 708 (HO); Snake Island, D'Entrecasteaux Channel, 18 Nov. 1984, K. Harris s.n. (HO 96981); Furneaux Group, Craggy Island, 6 Nov. 1972, J. S. Whinray (HO); Grown at Bridport from a specimen collected from North East Island, Kent Group, Jan. 1985, B. Bensemann s.n. (HO 97090).

Victoria—Glenaire Beach near Castle Cove, 21 May 1988, A. M. Buchanan 10939 (HO).

ETYMOLOGY:

Ramifer, branch-bearing, from the branching habit of the culms.

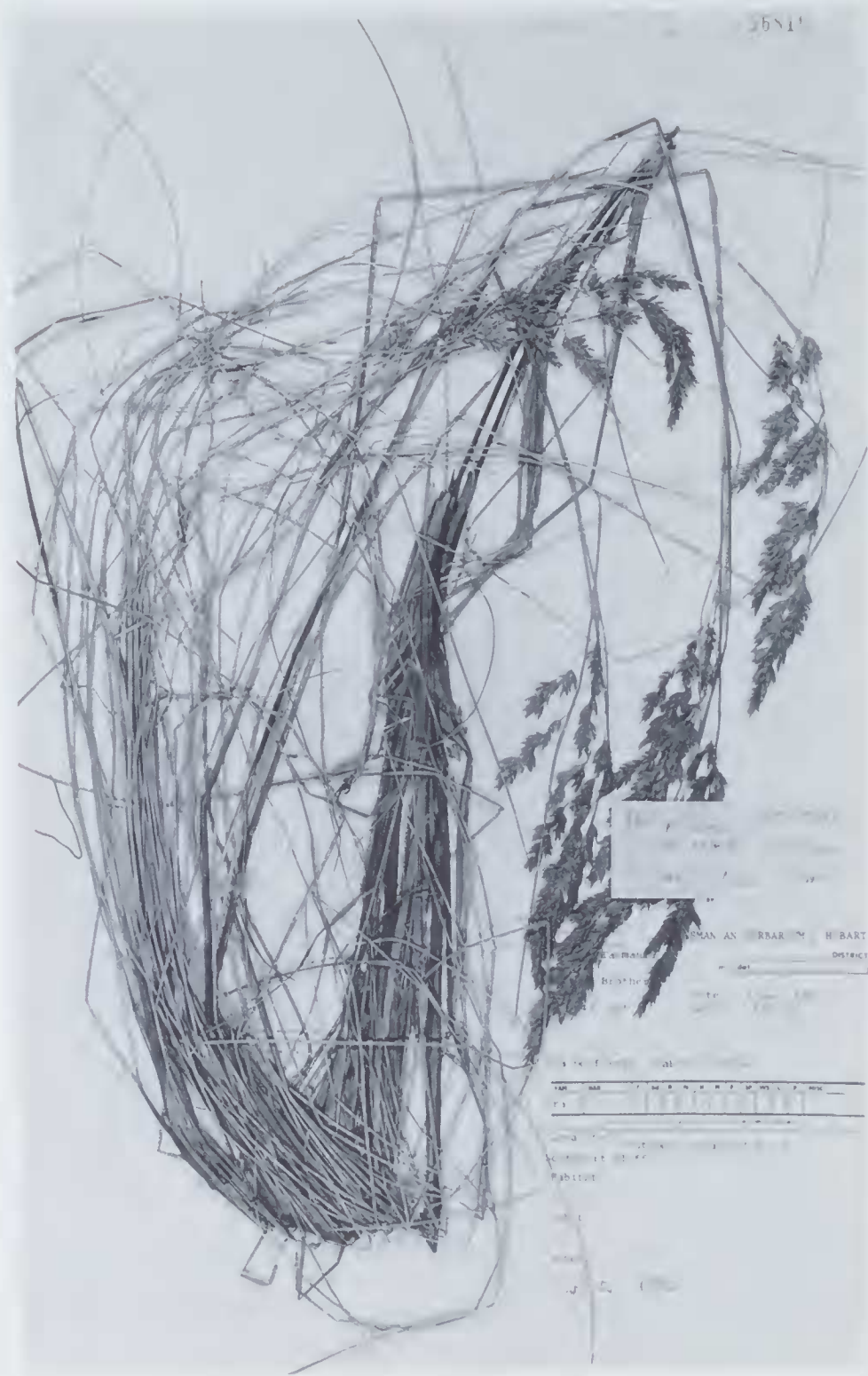


Fig. 16. Holotype of *Poa poiformis* var. *ramifer*.

ACKNOWLEDGEMENTS

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